

### Remarks

Further and favorable reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

Thus, claims 1, 3, 15 and 17 have been amended to clarify the invention, and to avoid the use of product-by-process language, referred to by the Examiner at the top of page 3 of the Office Action.

#### Bases of the amendments are as follows

##### (1) Urethane group and Urea group

As well known in the art, an isocyanate group of polyisocyanate compound (A) preferentially reacts with a hydroxyl group and an amino group rather than a carboxyl group to form a urethane group (linkage) and a urea group (linkage).

##### (2) A prepolymer having a isocyanate group and a carboxyl group

The reaction of polyisocyanate compound (A) with polyhydroxyalkanecarboxylic acid (B) forms a prepolymer having a carboxyl group and residues of components (A) and (B) which bond through a urethane group (see paragraph [0047] of the specification).

##### (3) Neutralization

The acid group (carboxyl group) of the polyurethane resin is neutralized with a neutralizing agent (or base) (see paragraphs [0047] and [0044]).

##### (4) Chain-extension agent and the formation of the urea group

Further, since the chain-extension agent has an amino group, the reaction of the prepolymer with the chain-extension agent produces an aqueous polyurethane resin having the urea group (linkage) in addition to the urethane group (linkage) (see paragraph [0047]).

Applicants take the position that these amendments should be entered, even though they are being presented after a final rejection, since the effect of the amendments is to clearly place the application in condition for allowance.

The patentability of the presently claimed invention after entry of the foregoing amendments, over the disclosures of the references relied upon by the Examiner in rejecting the claims, will be apparent upon consideration of the following remarks.

Thus, all of the rejections set forth by the Examiner in items 2-6 on pages 2-15 of the Office Action are respectfully traversed.

### Cited references

(1) The Uchida (US 6,979,493) and Uchida (US 6,569,533) references have been discussed in Applicants' previous response.

(2) Harada (US 5,981,029)

This reference discloses a gas-barrier film comprising a water-soluble or water dispersible polymer (including a polyurethane), inorganic stratified particles and an amine, as shown below.

### Abstract

A gas barrier film comprises a thermoplastic resin substrate and on the substrate a gas barrier coating, which coating comprises a water soluble or water dispersible high polymer and inorganic stratified particles. --- . In an alternative film, the gas barrier coating contains an amine compound represented by the following general formula:  $R_1-N(-R_2)-R_3$  where  $R_1$  stands for a hydrogen atom, or a  $C_{1-6}$  alkyl or allyl or phenyl group;  $R_2$  stands for a hydrogen atom, or an optionally substrated alkyl or allyl group; and  $R_3$  stands for an optionally substituted alkyl or allyl group.

### Column 2, line 56 to Column 3, line 8 (inorganic stratified particles)

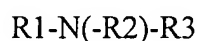
The inorganic stratified particles present in the gas barrier coating of a film embodying the present invention may be provided by an inorganic particles formed by overlapping one to several very thin unit crystal layers. Among them, especially a clay is preferably used. A particularly suitable clay of this type has a crystal structure capable of coordinating and absorbing water in the clearances between respective very thin unit crystal layers to allow swelling, ---. The clay can be natural or synthetic. Typical clays include kaolinite, halloysite, montmorillonite, vermiculite, saponite, dickite, nacrite, antiogorite, pyrophyllite, hectorite, beidellite, margarite, talc, tetrasilylic mica, muscovite, phlogopite and chlorite. Among them, inorganic stratified particles called smectites such as montmorillonite, saponite, hectorite and beidellite are preferably used.

### Column 3, lines 19-31 (water soluble or water dispersible polymers)

The water soluble or water dispersible high polymer of the gas barrier coating of a film embodying the present invention is preferably a high polymer which can be easily dissolved or finely dispersed in water at room temperature, and can be selected, for example, from polyvinyl alcohol based polymers and their derivatives, cellulose derivatives such as carboxymethyl cellulose and hydroxyethyl cellulose, starches such as oxidized starch, etherified starch and dextrin, polyvinyl pyrrolidone, copolymerized polyesters containing polar groups such as sulfoisophthalic acid, vinyl based polymers such as polyhydroxyethyl methacrylate and its copolymers, acrylic high polymers, **urethane based high polymers**, ether based high polymers,

Column 4, lines 6-53 (amine)

In accordance with another aspect of the present invention, **improvement in adhesiveness and post-lamination gas barrierability** is rendered possible by providing in the coating an amine represented by the following general formula:



--- The amine compounds which can be used include alkylamines such as propylamine, diethylamine, butylamine and hexylamine, amino alcohols such as aminoethyl alcohol, aminohexyl alcohol and aminoethylamino ethanol, **diamines** such as ethylenediamine, propylenediamine, amino acids such as aminoacetic acid, aminohexanoic acid and aminododecanoic acid, silane coupling agent having amino group such as  $\gamma$ -aminopropyltriethoxysilane,

$\gamma$ -(2-aminoethyl)-aminopropyltrimethoxysilane,

$\gamma$ -(2-aminoethyl)-aminopropyldimethoxysilane,

$\gamma$ -aminoisopropyl-trimethoxysilane,

$\gamma$ -ureidopropyltriethoxysilane. Among them,  $C_{1-4}$  alkylamines such as propylamine, diethylamine or butylamine, amino acids with 1-4 carbon atoms such as aminoacetic acid, aminohexanoic acid and silane coupling agents having amino and alkoxysilane groups at both molecular ends such as  $\gamma$ -aminopropyl-triethoxysilane and  $\gamma$ -(2-aminoethyl)aminopropyl-trimethoxysilane can be preferably used it is preferable that the amine compound is present in an amount of 0.01 to 40 wt % based on the total weight of the components of the coating.

### Patentability Arguments

However, the cited references fail to teach or suggest the combination of the polyurethane resin (i) having the acid group and the polyamine compound (iii). That is, one of ordinary skill in the art would not be motivated to select the specific proportion of the acid group of the polyurethane resin (i) relative to the basic nitrogen atom of the polyamine compound (iii) as described below.

In this regard, the examiner alleges that Uchida exemplifies 3[N-(2-aminoethyl)amino] propylmethyldimethoxysilane in Production Example 10 (see page 5, the second paragraph and pages 10 to 11 of the Office Action).

However, the combination of the swelling inorganic layered compound and the polyamine could not be arrived at from Uchida since the polyurethane resin obtained in Production Example 9, which is used in Production Example 9, does not contain the swelling inorganic layered compound.

Further, the Examiner alleges that "Uchida teaches that a polyamine can be used together with the diamine chain extending compound" (Uchida '493: col 5, lines 9-11, Uchida '533: col 5, lines 4-6).

However, it should be noted that the diamine as well as the polyamine are exemplified as the chain extending agent or crosslinking agent (see Uchida '493: col 4, lines 54 -55, Uchida '533: col 4, lines 48-49). Particularly, the diamine as well as the polyamine as the chain extending agent is incorporated into the polyurethane skeleton by reacting an isocyanate group of the prepolymer with an amino group of the diamine and/or polyamine, and thus the diamine and/or the polyamine is not present in the free form in the aqueous polyurethane resin.

Furthermore, the Examiner alleges that "Harada teaches a gas barrier film containing an amine compound for use in a variety of polymers including urethane based polymers (see col 3, line 30-31) which can be compounds including alkylamines and alkylene amines (see col 4, line 6-36)", and that "This amine yields an improvement in adhesiveness and post-lamination gas barrierability (see col 4, line 7-9)".

However, the Harada reference fails to teach carboxyl groups of the polyurethane. In this respect, please note that there are various water soluble or water dispersible urethane based polymers such as a polyurethane having a hydrophilic unit (e. g., a polyoxyethylene unit), a polyurethane emulsified with an emulsifier such as surfactants, a polyurethane emulsion obtained

by emulsion-polymerization of a polymerizable monomer or prepolymer having a urethane bond or linkage, or the like. Further, the meanings or importance of the carboxyl groups of the polyurethane is not taught by the Harada reference. That is, the reference fails to provide any guidance for combined use of the polyurethane resin (i) having the carboxyl group and a free amino compound (iii). Please note that the polyamine compound (iii) is not bonded to the polyurethane resin and is present in the free form in the aqueous polyurethane resin, as apparent from the fact that the polyamine compound is interposed or inserted between the layers of the swelling inorganic layered compound (see page 21, lines 1-9 of the present specification). Accordingly, even if the Uchida references were combined with the Harada reference, the art-skilled would not necessarily arrive at the ratio of the acid group (carboxyl group) of the polyurethane resin (i) relative to the basic nitrogen atom of the polyamine compound (iii) as presently claimed.

Thus, the above ratio of the carboxyl group of the resin (i) relative to the basic nitrogen atom of the free polyamine compound (iii) would never be predictable or obvious over the Uchida references in view of Harada reference.

Moreover, according to the present invention, gas barrier properties are remarkably improved even under highly humid conditions, as apparent from the Examples in the specification. In more detail, as apparent from Comparative Examples 1-2, the absence of polyamine deteriorates the oxygen permeability under the condition of 80%RH to 24.0-27.4. Further, the absence of the inorganic layered compound provides higher oxygen permeability such as 45 (under 50%RH) and 139 (under 80%RH) (see Comparative Example 3).

Contrarily, the combined use of the inorganic layered compound with the polyamine improves the oxygen permeability significantly even under a highly humid condition of 80%RH. This is clearly proved from Example 7, using the same inorganic layered compound and the polyamine as in the Comparative Examples 1 and 3, showing that the oxygen permeability is remarkably improved from 6.2 and 45 (Comparative Examples 1 and 3) to "1.8" (under 50%RH), particularly 24.0 and 139 (Comparative Examples 1 and 3) to "5.2" (under 80%RH). It is surprising that the oxygen permeability of Example 7 is improved by three times or more under a less humid condition and by 4.5 times or more under a highly humid condition in comparison with Comparative Examples 1 and 3. Further, it should be noted that the arithmetic average of the oxygen permeability of Comparative Examples 1 and 3 is  $25.6 = (6.2 + 45) / 2$  (under

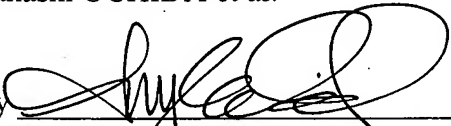
a less humid condition) and  $82 = (24.0 + 139) / 2$  (under a highly humid condition), while the oxygen permeability of Example 7 is "1.8" (under a less humid condition), which is remarkably lower (14 times or less) relative to the arithmetic average and "5.2" (under a highly humid condition), which is significantly lower value (15 times or less) relative to the arithmetic average. These synergistic effects would never be predicted from the cited references.

For these reasons, Applicants take the position that the presently claimed invention is clearly patentable over the applied references.

Therefore, in view of the foregoing amendments and remarks, it is submitted that each of the grounds of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

Respectfully submitted,

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